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Spin Currents in Magnetic Insulator/Normal Metal Heterostructures

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The generation and the detection of pure spin currents are fascinating challenges in modern solid state physics. In ferromagnet/normal metal thin film heterostructures, pure spin currents can be generated, e.g., by means of spin pumping [1], or via the application of thermal gradients in the so-called spin Seebeck effect [2]. An elegant scheme for detecting spin currents relies on the inverse spin Hall effect: Owing to spin-orbit coupling, a spin current flowing in a normal metal also induces a charge current, which can be straightforwardly detected using conventional electronics [1,2].

In the talk, I will discuss some of our recent spin current-related experiments in magnetic insulator/normal metal heterostructures [3-5]. Magnetic insulators are very attractive materials for spin current experiments, since they do exhibit long-range magnetic order and thus can sustain pure (magnonic) spin current flow, while they do not conduct electrical charge. We take advantage of this fact and study the spin Seebeck effect in both yttrium iron garnet (Y3Fe5O12, YIG) as well as gadolinium iron garnet (Gd3Fe5O12, GdIG) based heterostructures [5]. While the spin Seebeck voltage in YIG/Pt heterostructures "simply" goes to zero upon decreasing temperature, it changes sing twice in GdIG/Pt. The spin currents thus do not simply replicate the net magnetization of the ferrimagnetic insulator, but rather reflect the complex interplay between the different magnetic sublattices. Furthermore, I will introduce and discuss the so-called spin Hall magnetoresistance effect in these heterostructures [3,4].

References:

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